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ABSTRACT

A study identified effective teaching strategies by constructing and comparing the teaching profiles of two eighth grade mathematics teachers whose students made significant achievement gains over the school year. This paper describes procedures used to select successful teachers within classroom groups having students with equivalent cognitive entry skills. It then compares the classroom situations and teaching strategies of the two successful teachers with the other teachers. The analysis indicated that gain in mathematics achievement in these two classes could not be attributed to differences in students' home background, class size, number of mathematics lessons per week, or teacher workload. However, the profiled teachers used different teaching strategies than their colleagues. One used an extremely organized approach to teaching wherein material was taught until mastered, thereby reducing the need to review work frequently. The other used an approach emphasizing the presentation of material followed by extensive practice in applying the material to new situations. Although both teachers placed emphasis on new material rather than on review, there were differences between their teaching practices. These differences reflected the success of both teachers in diagnosing the particular abilities of their students and adopting appropriate teaching strategies. (JD)

PROFILES OF EFFECTIVE TEACHERS OF GRADE 8 MATHEMATICS

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The IEA Classroom Environment Study (CES) carried out in ten countries was conceived of as process-product research into teaching and student achievement. It sought to build a complex model of classroom interactions, linking classroom context and teaching practices to student achievement (Anderson and Ryan, 1984).

The relationships among the elements of this model, and in particular the identification of effective teaching practices, were tested through the use of multiple-regression analyses and various path-analysis techniques. This approach, however, is fraught with a number of practical and conceptual difficulties when the number of classes represented in the data is not large enough.

Because of these difficulties (e.g., estimating meaningful regression weights), such analyses of the effect of individual teaching and learning variables on posttest achievement scores do not often lead to the identification of successful teaching strategies. Rather, there is great potential value in alternative means of differentiating the successful from the less successful teacher. This paper presents an attempt to identify effective teaching strategies by constructing and comparing the teaching profiles of teachers whose students made significant achievement gains over the course of the school year.

In constructing these profiles it is necessary to take into account that teaching behaviours may be influenced by a number of factors. Probably the most important of these factors are the entry characteristics of the students, since teaching behaviours effective for particular groups of students may not be effective for others, these entry characteristics include the home backgrounds of the students and their prior cognitive achievement in the subject of concern. Teaching behaviours may be further influenced by classroom charac-

teristics such as class size and time allocated for instruction in the subject, factors over which teachers may have little control, or by whether the teacher is assigned to teach several subjects to a core student group or to teach one subject to several classes. Finally, teaching behaviour may also be influenced by the subject matter itself. In developing the profiles, therefore, an attempt was made to control for initial achievement levels, and to examine the other classroom characteristics described above.

This paper describes the statistical procedures used to select successful teachers within classroom groups having students with equivalent cognitive entry skills. It then compares the classroom situations and teaching strategies of successful teachers with those of both the other teachers in their group and the total sample of teachers.

Identification of Effective Teachers

Since the primary objective in developing the profiles was to look for teaching patterns associated with significant student achievement gains, it was first necessary to identify classes showing such gains during the school year. The first step was to inspect the means and standard deviations of the student pretest achievement scores. The classes were then separated into three groups on the basis of their mean pretest scores. Analyses of variance carried out for each group separately yielded all $F < 1.0$, indicating that the pretest means of the classes were homogeneous within each group. (There were five classes in Group 1, seven in Group 2, and six in Group 3.)[1]

The second step was to identify those classes for which the achievement gain was larger than for the other classes in the same group, this was done by comparing the posttest achievement scores of the classes within each of the three groups by means of a second series of analyses of variance. The posttest means for classes within both Groups 1 and 2 were found to be significantly different ($F_{4,111} = 9.65$, $p < 0.01$ and $F_{6,169} = 3.14$, $p < 0.05$, respectively); there were no differences in posttest means for classes in Group 3 ($F < 1.0$). Newman-Keuls

[1]The final set of three groups included eighteen of the twenty three classes. The remaining five classes could not be added to any of the groups, since to do so resulted in pretest class means which were significantly different, nor could they form a separate grouping of classes with equivalent pretest achievement scores

tests were subsequently conducted on the posttest means for Groups 1 and 2. Within Group 1, the posttest achievement mean for Classroom 331 was found to be significantly greater than the means for other classes in the group, in Group 2, the posttest achievement mean for Classroom 101 was found to be significantly greater than the remaining class means.

The mean pretest and posttest achievement scores for classes within each of the three groups are shown in Table 1. In terms of their pretest standings in comparison with the total student sample, the students in Group 1 were below average, those in Group 2 average, and those in Group 3 above average. Within the low entry achievement group (Group 1), the students in Classroom 331 exhibited a gain of 15.6 at the end of the school year, well above the average gain of 7.2 in the other four classes. Within the middle or "average" entry group (Group 2), the gain in Classroom 101 was 9.9, whereas the average gain of the other six classes was 5.9.

Classrooms 101 and 331 were then compared with their respective subgroups on a variety of dimensions, to attempt to identify factors that might have contributed to increased student achievement. The classes were not compared on the full range of variables available in the data, most of the variables selected were ones found to be either positively or negatively correlated with posttest achievement for the total sample of students. In all of these comparisons, teacher or student data for each profiled class were compared with the teacher or student data for the classes in its subgroup. The relevant data for the full sample of twenty-three mathematics classes were also examined.

Contextual Variables

Comparison of Student Characteristics

Previous research has shown that the characteristics of the students themselves are the best predictors of how well the students will do in school (Walberg, 1979). Indeed, for the total sample of mathematics students, a good many student entry characteristics (including student pretest achievement score, father's occupation, language spoken in the home, student attitudes toward mathematics, and student perceptions of his/her ability in mathematics) were positively and significantly correlated with posttest score.

Table 1

Mean Pre and Posttest Mathematics Achievement Scores by Classroom within Each of Three Groups Identified on the Basis of Equivalent Student Entry Performance

	Classroom Group	Class Number	Mean Pretest Mathematics Score	Mean Posttest Mathematics Score	Mean Achievement Gain
Group 1:	Low Entry Performance	201	14.1	21.8	7.7
		222	14.0	17.3	3.3
		301	13.5	19.5	6.0
		312	14.1	18.2	4.1
		331	**13.6**	**29.2**	**15.6**
	Mean of Means		13.8	21.1	7.2
Group 2:	Average Entry Performance	**101**	**16.7**	**26.6**	**9.9**
		111	16.8	21.3	4.5
		112	16.4	22.2	5.7
		151	16.5	20.6	4.0
		202	15.1	23.0	8.0
		302	15.0	18.5	3.5
		421	16.9	22.5	5.6
	Mean of Means		16.2	22.1	5.9
Group 3:	Above Average Entry Performance	121	19.7	22.5	2.8
		131	18.5	25.5	7.0
		141	17.3	22.9	5.6
		161	18.0	23.7	5.7
		311	19.8	24.8	4.9
		411	19.8	24.2	4.4
	Mean of Means		18.8	23.9	5.1

Because the methods used to identify successful teachers within groups of classes took into account the mean initial achievement (a widely recognized proxy for ability), the significantly greater mean gain in achievement of students in Classrooms 101 and 331, in comparison with their respective subgroups, cannot be attributed to differences in initial abilities. Nor, as Table 2 indicates, can the higher achievement gains in these two classes (again in comparison with their subgroups) be attributed to other student characteristics.

With respect to the sex of the students, for example, there were approximately equal numbers of boys and girls in each of the profiled classes and in each of their respective subgroups. These data also matched those for the full sample of twenty-three classes.

Looking at the socioeconomic status (SES), as assessed by the father's occupation reported by the student, the mean SES of students in Group 2 and in the profiled Classroom 101 corresponded exactly to the mean SES of students across the full sample of twenty-three classes. The mean SES status of students in Group 1 was only slightly lower than that of both Group 2 and the total sample. Interestingly, students in the other profiled class (331) were generally from homes in which the SES status was markedly lower. Since for the total student sample the overall correlation between posttest achievement and level of father's occupation was positive and statistically significant, Classroom 331 might have been expected to make a relatively small gain in achievement across the school year. In fact, the mean gain for this class was found to be the largest of all the classes in our sample of twenty-three. Thus, while lower SES may have contributed to the poor performance of this class at the start of the school year, it certainly did not appear to have contributed negatively to its mean performance at year-end.

Similarly, there were few differences among the two subgroups, the profiled Classroom 101, and the full sample of mathematics classes on measures of the father's educational level. Students in Group 2, including Classroom 101, were generally from homes in which the use of English was somewhat more common than for the total sample. Note that in Classroom 331 the mean educational level of the students' fathers was much lower than for the other classes, and languages other than English were spoken in many more homes. Clearly, the instruc-

Table 2

Comparisons of Mean Student Characteristics in the Profiled Mathematics Classes, Their Respective Subgroups, and the Total Classroom Sample

Student Characteristics	Means for Classroom Group 1 (Low Entry) Class-room 331	Sub-group (N=4)	Means for Classroom Group 2 (Average Entry) Class-room 101	Sub-group (N=6)	Means for Total Classroom Sample (N=23)
Sex of Students					
1 = Female; 2 = Male	1.5	1.5	1.5	1.5	1.5
Socioeconomic status of students' families (based on fathers' occupations):					
1 = unskilled 2 = skilled 3 = clerical/sales 4 = salaried professional 5 = upper-level professional	1.6	2.3	2.4	2.5	2.5
Fathers' educational level:					
1 = less than primary 2 = primary 3 = secondary 4 = post-secondary	2 1	3.2	3.3	3.3	3.2
Language spoken in the home:					
1 = little, if any, English 2 = English sometimes 3 = English usually 4 = English only	2.2	3.0	3.8	3.7	3.4
Teachers' assessments of numbers of students needing remedial help:					
1 = none 2 = some 3 = half 4 = a good many 5 = all	5.0	2.0	2.0	2.0	2.4

tional processes at work in Classroom 331 were remarkably successful in overcoming these two potentially negative environmental variables.

The final student entry characteristic included in the profile was the teacher's assessment of the extent to which the students in his/her mathematics class entered the Grade 8 year requiring remediation in mathematics. As Table 2 shows, both the teacher of profiled Classroom 101 and the teachers (on average) of the classes in its subgroup (2) reported that only some of the students needed remediation.

In contrast to the other teachers, profiled Teacher 331 (in Group 1) reported that *all* of the students in his/her class entered the Grade 8 year in need of remedial assistance in mathematics, and the low pretest mean score supports this perception. Teacher 331 was clearly very aware of the needs of the students in the class and, considering the very high mean posttest score, was successful in developing a mathematics program which met those needs.

In sum, the significant mean achievement gains in Classrooms 331 and 101 could not have been predicted on the basis of socioeconomic status and parental education. While the students in Classroom 331 differed in these characteristics from the students in the subgroup and in the total sample classes, the differences were in a direction that would have lead to a prediction of extremely low mean gains. Nor can the greater gain in achievement in Classroom 101 be attributed to student entry characteristics, since there were few differences between Classroom 101 and the other classes in its subgroup in terms of average student characteristics.

Comparison of Classroom Characteristics

Included in the profile analyses are two classroom characteristics found to be significantly related to posttest achievement within the full sample of twenty-three classes. class size and the average amount of mathematics instruction per week. While class size was positively correlated with posttest scores, the average number of minutes devoted to mathematics instruction per week was negatively correlated.

The number of students in the two profiled classes are shown in Table 3, as well as the average number of students in classes in the two subgroups and in the full sample of twenty-three classes. Clearly it cannot be argued that the significant mean student gains in achievement in Classrooms 331 and 101 were attributable to smaller class size, since the two profiled classes were larger than the average in their respective subgroups. Neither can it be argued that the mean gains shown in Classrooms 331 and 101 were due to a different amount of class time devoted each week to mathematics. As the figures in Table 3 show, Classrooms 331 and 101 received *slightly less* mathematics instruction per week than did, on average, the classes in their respective subgroups or the sample as a whole.

Table 3

A Comparison of the Two Profiled Mathematics Classes with Their Respective Subgroups and the Full Sample of Mathematics Classes on Selected Class Characteristics

Classroom Group		Class Size	Amount of Math Instruction per Week (min.)
Group 1:	Class 331	25	175
	Subgroup Mean (N=4)	22	187
Group 2:	Class 101	27	175
	Subgroup Mean (N=6)	24	196
Full Sample Mean (N=23)		28	222

Comparison of Teacher Assignments

The two teacher workload characteristics which were included in the profile analyses were the number of periods of mathematics and the number of additional subjects taught. For the total sample, each of these variables was found to correlate negatively with posttest score.

With respect to the number of mathematics periods taught per week, we found differences between the two profiled teachers and their respective subgroups and between these groups and the full sample of classes, as Table 4 indicates. Within the sample as a whole, the teachers taught, on average, ten periods of mathematics per week. Within Group 1, Teacher 331 taught only five periods of mathematics per week, i.e., he/she taught mathematics to the observed class only. The teachers in that subgroup taught, on average, approximately six mathematics periods per week. Thus Teacher 331 and the other teachers in Group 1 taught approximately half as many mathematics periods per week as were taught by the twenty-three teachers, on average. Quite a different pattern emerged in Group 2. Teacher 101 taught seventeen mathematics lessons per week, i.e., he/she taught mathematics to more than just the observed class, while the other teachers in Group 2 taught, on average, twelve mathematics periods per week.

In sum, Group 1 teachers taught mathematics just to the observed class and are "core" teachers. Group 2 teachers tended to teach mathematics to more than just the observed class and might be considered to be primarily mathematics teachers. The profiled teachers did not differ from their subgroup colleagues in this respect ("core" versus "rotary"). It appears that Teacher 101 taught one more class of mathematics than did his/her subgroup peers, the higher achievement gain in Classroom 101 would thus not have been predicted by the overall correlation.

Not surprisingly, the teachers' reports of the number of subjects taught in addition to mathematics is inversely related to the number of mathematics classes taught per week. For Group 1, more subjects were taught, on average, than in the full sample. Profiled Teacher 331 taught one fewer additional subject than did his/her subgroup peers, on average. For Group 2, Teacher 101 also taught one fewer additional subject than did the remaining Group 2 teachers, on average.

Clearly, there is no simple relationship between student achievement in a specific classroom and either the number of classes taught by a teacher in the specific subject or the number of additional subjects taught by the teacher. The underlying variable of importance

Table 4

A Comparison of the Teaching Assignments of Two Profiled Mathematics Teachers with those of Teachers in Their Respective Subgroups and the Full Sample of Mathematics Teachers

Classroom Grouping		Number of Periods of Mathematics Taught per Week	Number of Additional Subjects Taught
Group 1:	Teacher 331	5	4
	Subgroup Mean (N=4)	5.7	5
Group 2:	Teacher 101	17	2
	Subgroup Mean (N=6)	12	3
Full Sample Mean (N=23)		10	3

may not be the nature of teaching assignments or workload, but rather the approach to instruction. It may well be, for example, that teachers of core groups (who teach, therefore, fewer separate classes in a subject area) tend on average to know their students better and thus to design more appropriate instruction. However, this hypothesis is only supported by the achievement gains in Classroom 331 and not by those in the other Group 1 classes.

Summary of Contextual Variables

It was hoped that comparisons of the profiled teachers with their respective subgroups on a variety of contextual variables, including student and classroom characteristics and teaching assignments, would identify variables which might help to explain the significant achievement gains in the profiled classes in comparison with their subgroups or the total sample. In general, the analyses did not yield any such explanatory variables. The profiled

classes generally did not differ from their subgroup peers or, where they did differ, did so in ways that would not have been expected to contribute to greater learning. Indeed, it could be argued that for one of the profiled classes (331) the contextual analyses would have led to an incorrect prediction of very small mean student gains.

Instructional and Management Strategies

The paper now turns to an examination of some instructional and management practices which may have contributed to the significant achievement gains in the two profiled classes. As noted previously, the analysis did not include the full set of instructional and management variables in the profile analyses, but focused primarily on those which were found to bear an overall significant relationship to posttest achievement, either positive or negative. It also included some variables, descriptive of teaching strategies, which were dropped from the correlational analyses because of low frequency of occurrence, little variability, or lack of significant overall correlation. Some of these are included here because it is important to ascertain whether the two highly successful teachers (331 and 101) differed from their subgroup colleagues on these variables. The data for the variables were obtained from the Final Teacher Questionnaire, the Pre-observation Interview, and the Snapshot Comments made by the two profiled teachers during the open-ended Teacher Interview are also reported.

Information about the teaching practices used by the teachers during mathematics classes was obtained from two distinct sources: from teachers' reports of their preferred teaching practices, planned instructional intentions and planned emphases for a sample of lessons, and from observations conducted during that sample of lessons. The profile analyses make use of both sources of information.

Figures are presented to provide visual comparisons of the differences and similarities between the two profiled teachers and their respective subgroups and among the profiled teachers, the subgroups, and the total sample of mathematics teachers. Information in the figures may be used to answer two major questions of importance in differentiating between more and less effective teaching strategies:

1. Did the successful teachers (331 and 101) differ from their respective subgroups (and the total teacher sample) in their teaching practices and strategies?

2. Were the teaching practices and strategies used by Teachers 331 and 101 similar?

A positive answer to question 1 would suggest that further examination could identify teaching styles that are more effective than others with groups of students having comparable cognitive entry skills in mathematics. A negative or ambiguous answer, on the other hand, would indicate that other factors account for the differences in achievement gains. If question 1 is answered in the affirmative, it is then useful to examine question 2. a positive answer would indicate that teaching styles effective for students with low entry skills are similarly effective for those with average entry skills. A negative answer to question 2 would indicate that different teaching practices are likely to be effective with different groups of students.

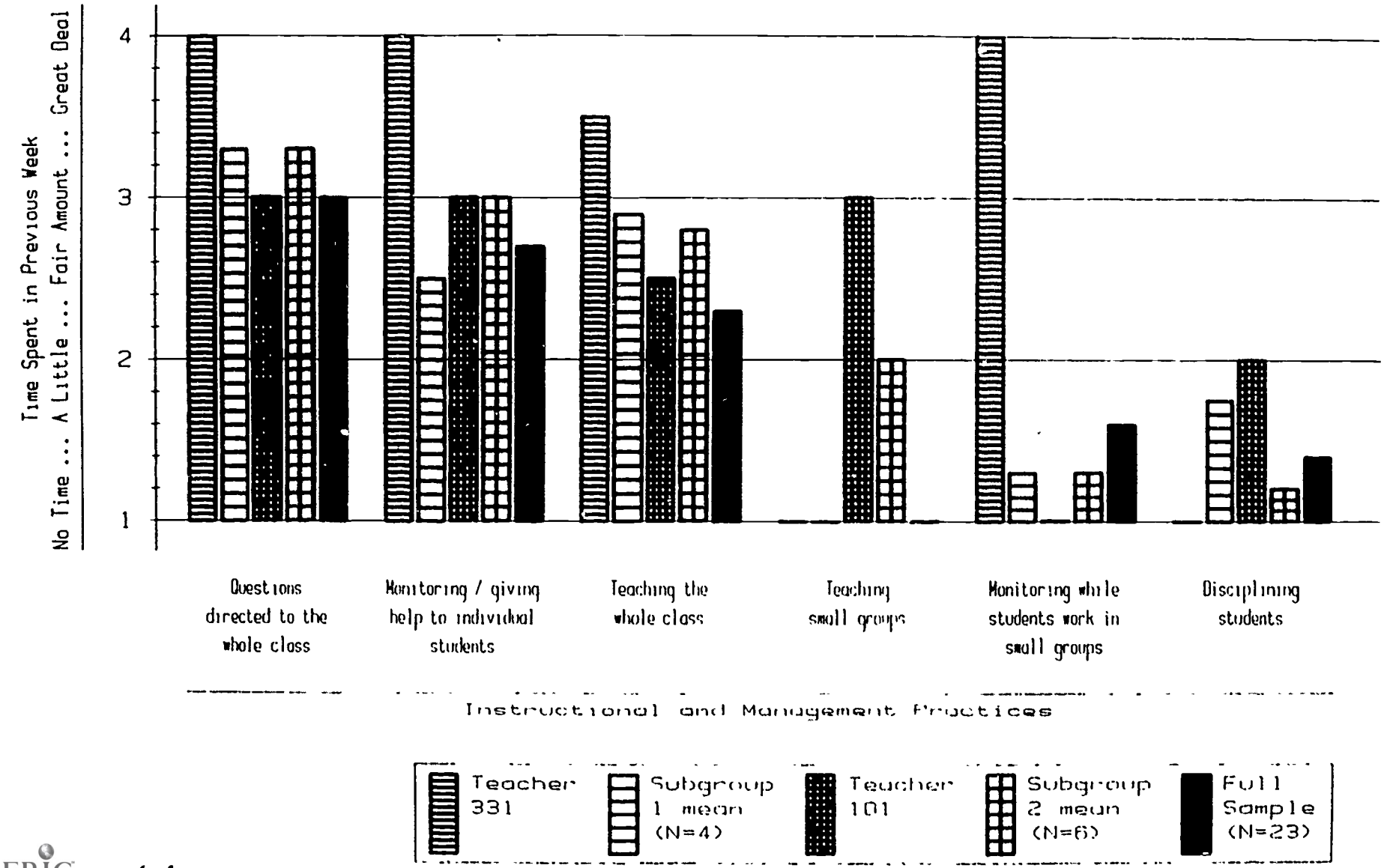
Comparison of Teachers' Reports of Their Preferred Teaching Practices

As noted previously, the Final Teacher Questionnaire required the teacher to identify the teaching methods he/she had used over a specified one-week period while teaching mathematics to the observed class. The teachers also indicated how much time they had given to the use of each of the methods during that week. These data were interpreted as an indicator of the teachers' preferred teaching styles and are presented in Figure 1. The data are presented separately for the two profiled teachers, the teachers in the respective subgroups (average frequency), and for the full sample of twenty-three mathematics teachers (average frequency).

As shown in Figure 1, profiled Teacher 331 differed from his/her subgroup on the reported use of each practice in the previous week except that of teaching small groups, a practice neither had used at all. The use of the various strategies as reported by Teacher 331 was also different from the average use reported by the other subgroup and the full teacher sample. In fact, Teacher 331 reported the highest frequency of use of several strategies (whole-class teaching and questioning, and monitoring of both individual and small-group seatwork), suggesting that this teacher varied his/her strategies often during the course of a week's lessons. This was confirmed in the Teacher Interview with Teacher 331 who stated:

FIGURE 1

Comparisons of Two Profiled Teachers, their Respective Subgroups, and the Total Sample of Mathematics Teachers on Time Reported to be Given to Various Instructional and Management Practices



"Mine are short-term objectives, always followed up to see if learning really took place--although I teach mostly as a class, there is a lot of individual follow-up. I go up and down the rows while they are doing the work so they don't get a chance to become frustrated. That prevents discipline problems."

Profiled Teacher 101 also differed somewhat from his/her subgroup on the reported frequencies of use of all the practices except that of monitoring individual student seatwork. The differences, however, were not as large as were those between Teacher 331 and Group 1. Indeed, both Teacher 101 and the teachers in Group 2 on average reported patterns of use similar to those for the full sample. The largest differences were in Teacher 101's reports of more frequent teaching of small groups and more time spent in disciplining students. In the Post-observation Teacher Interview, Teacher 101 explained that the students in Classroom 101 included some from Grade 7. The teaching strategy, therefore, was to teach the whole class for a period of time, then divide the class into groups on the basis of ability and work with the groups on a more individual basis. The more frequent use of small-group instruction may help to explain why Teacher 101 reported spending relatively more time on disciplining students. At any rate, the use of small-group instruction by Teacher 101 may well have been due to the demands of a split-grade class rather than to a preferred teaching strategy per se.

In sum, these self-reports indicated that the teaching approach preferred by Teacher 331 could be characterized as more dynamic and varied than the average; the teaching approach preferred by Teacher 101 tended toward the average pattern, although Teacher 101 also reported an unusually frequent use of teaching to small groups. These data, then, can be viewed as providing preliminary evidence that the teaching styles preferred by the two profiled teachers during mathematics lessons incorporated some components which were identifiably different from the styles preferred by their colleagues. These differences may have contributed to the significant gains in achievement of the students in the profiled classes. Given the more distinct pattern for Teacher 331, these analyses provide clues as to teaching practices that may be effective for students of low prior achievement in mathematics (as in Group 1).

Comparison of Planned Lesson Intentions and Planned Lesson Emphases

The teachers were asked to select one of four specified emphases and one of four specified intentions as best describing their own plans for each observed lesson. The frequency of selection of each emphasis and intention was then expressed as a percentage of the eight observed lessons per teacher. Figure 2 shows the relative frequency of each planned emphasis and planned intention for the two profiled teachers, the average frequencies for the teachers in their two subgroups, and, lastly, the average frequencies for the full sample of twenty-three mathematics teachers.

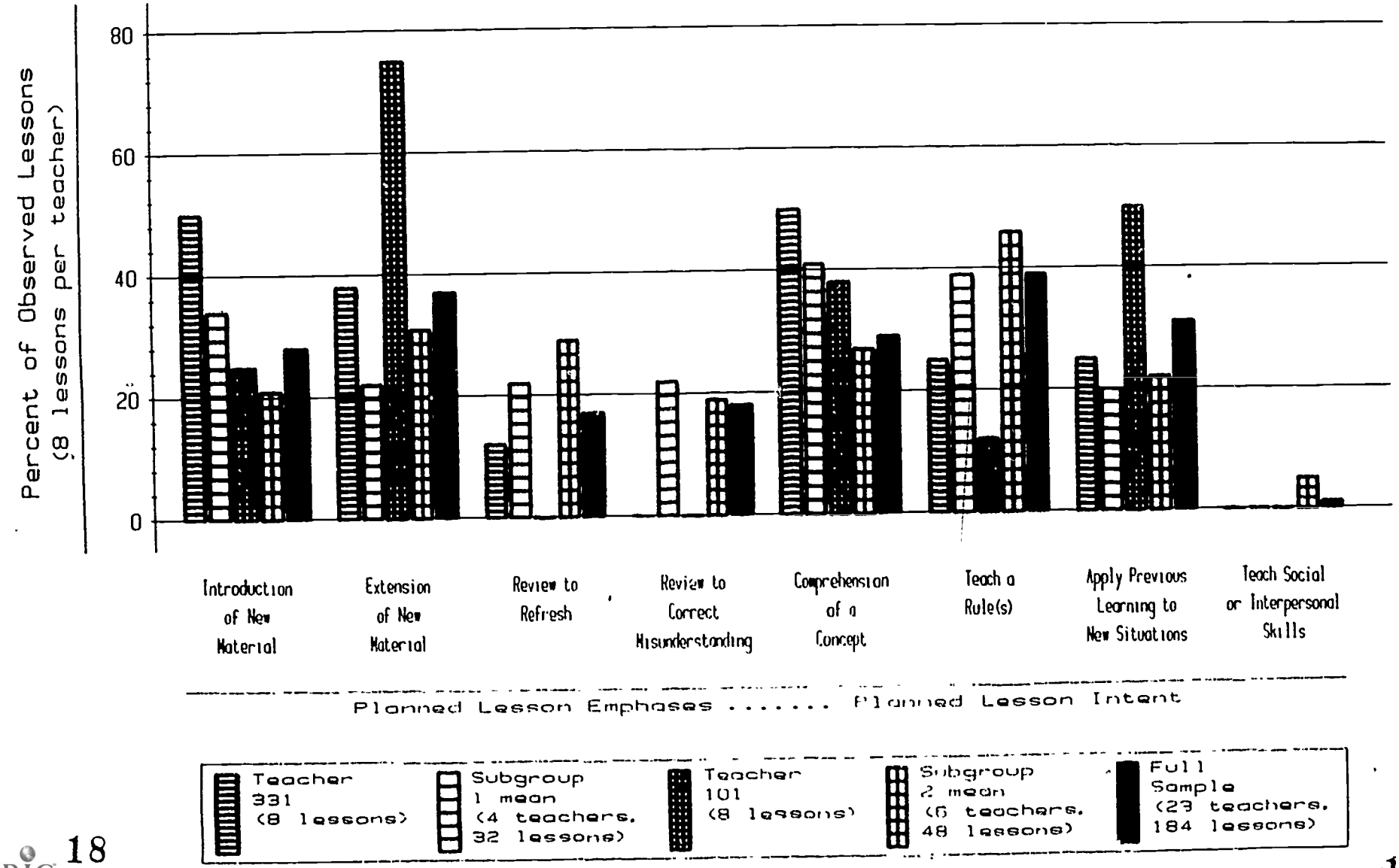
The planned lesson emphases reported by the two profiled teachers differed dramatically from those of their respective subgroups and of the total teacher sample. For example, seven (88 per cent) of Teacher 331's observed lessons and all eight of Teacher 101's observed lessons were planned to emphasize either the introduction or expansion of new material. The comparable figures for their subgroups were slightly more than four lessons on average (56 per cent and [illegible] per cent, respectively). Across the total sample, around five of the eight lessons (65 per cent) were similarly planned.

For not one of the eight observed mathematics lessons did Teacher 101 plan to review previously taught material either to refresh or to correct misunderstandings. Similarly, Teacher 331 reported little planned review (only one out of the eight observed mathematics lessons or 12 per cent planned for general review to refresh and none for correction). In contrast, Groups 1 and 2 on average reported almost four lessons devoted to some kind of review. Of these, 22 per cent and 19 per cent, respectively, were planned to correct misunderstandings of the students. Around three (35 per cent) of the observed lessons taught by the total teacher sample on average were devoted to review. Given the overall negative correlation between posttest scores and the frequencies of lessons planned both for general review and for corrective review, this secondary analysis has provided a clue to why Teachers 331 and 101 were more effective than their peers in enhancing the learning of their students.

For both Teachers 101 and 331, then, a large majority of the observed lessons were planned to emphasize the teaching of new material, either for purposes of introduction or

FIGURE 2

Comparison of the Planned Emphases and Intentions for the Observed Lessons of Two Profiled Teachers, their Respective Subgroups, and the Full Sample of Mathematics Teachers



expansion. Since the pretest mathematics achievement scores for the students in the two profiled classes were equivalent to the pretest achievement scores of students in the respective subgroups, it cannot be argued that the students in the profiled classes initially required less review in the sense of material they had failed to learn in previous school years. Indeed, Teacher 331 reported that all of the students in her class had entered the Grade 8 year already in need of remediation in mathematics. Thus a considerable proportion of Teacher 331's lessons would have been expected to have been be devoted to some kind of review. Since this was not the case and Teacher 331 was highly successful as judged by his/her students' posttest scores, it seems reasonable to assume that whatever prerequisite skills the students lacked were incorporated into the teaching of new material or the application (expansion) of new material. Indeed, the expansion of new material as a lesson emphasis was found to be positively correlated with posttest achievement across the total classroom sample.

With respect to the planned intentions for the observed mathematics lessons, the two profiled teachers were again different both from the average of their respective subgroups and from the full teacher sample. Teacher 331 reported that four of the eight observed lessons (50 per cent) were to be devoted to teaching the comprehension of a concept, with two each of the remaining four lessons being devoted to the teaching of rules and to the application of previous learning to new situations (i.e., problem solving). In comparison, the teachers in Group 1 on average reported somewhat greater stress on the teaching of rules and less on the teaching of both concepts and applications. The pattern for Teacher 101 was distinctly different from that for Teacher 331 and the other teacher groups. Teacher 101 reported that for four of the observed lessons (50 per cent) the major intention was the application of rules (problem solving), and that three lessons (38 per cent) were to be devoted to the comprehension of a concept. Only one lesson (12 per cent) was to be devoted primarily to the teaching of rules--the lowest frequency of any group. Further, Teacher 101 differed most from his/her subgroup (2) in terms of lessons planned to teach the application of previous learning to new situations. The teachers in Group 2 placed the greatest stress on lessons designed to teach a rule or rules.

Note that these reports on the lesson intentions for the two profiled teachers are quite

consistent with their planned emphases. Thus, for Teacher 101, the high incidence of the expansion of new material as a lesson emphasis was matched by the relatively high incidence of lessons to be devoted primarily to teaching the application of rules or previous learning to new situations. Similarly, for Teacher 331, the frequency of the planned emphasis on the introduction of new material is matched by the frequency of those lessons which were intended to teach the comprehension of a concept. The greater emphasis on review in the lessons planned on average by both respective subgroups and by the total sample is reflected in their intention to teach rules rather than concepts or applications.

If the eight observed lessons are representative of the teaching over the course of the entire year, it would appear that the two profiled teachers planned mathematics lessons which were markedly different from those planned by their colleagues.

In particular, it seems that the lesson emphases and intentions planned by Teacher 101 would be consistent with a teaching model that centres around the presentation of material followed by sufficient application of that material to ensure that the students have grasped the content. This interpretation is supported by the comment made by Teacher 101 during the final interview:

> "Once the topic has been presented and some examples have been shown, I expect them to work on their own. Instructing the class generally gives a lesson that may last the whole period and then they'll have a period to do the exercises. Generally I prepare lots of different examples for them to work through."

Further, it is plausible that the lesson emphases and intentions planned by Teacher 331 reflected a model of teaching in which a unit is taught until the concepts are mastered by the student, thereby reducing the need to plan entire lessons around the review of previously taught material. Again, this interpretation is reflected in the comments made by Teacher 331 during the final interview:

> "I never repeat a unit; I don't test a unit until the students know the material. If I think they have not learned the material I will approach it in a different way. I use alternative strategies a lot."

Though Teachers 331 and 101 put similar stress on new material, rather than review of

old, they differed in their instructional emphases and lesson intentions. These differences may reflect the teachers' accurate perceptions of the needs of their students rather than individual teaching styles. Since the students in Classroom 331 entered with low prior achievement in mathematics, for example, it seems appropriate that Teacher 331 supplemented his/her frequent lessons designed to teach new material with an occasional general review lesson, and placed somewhat greater stress on the teaching of rules. Since the students in Classroom 101 had average entry skills in mathematics, Teacher 101 likely was able to devote somewhat less time to the introduction of new material and to move more quickly to its expansion.

In sum, both in terms of preferred teaching strategies and in terms of the variety and type of planned instructional emphases and intentions, the self-reported patterns of the two profiled teachers reveal some interesting and potentially significant differences from those of teachers whose students began the school year with very similar entry characteristics. Some observational data is examined next to ascertain whether or not the classroom observations support these suggested differences.

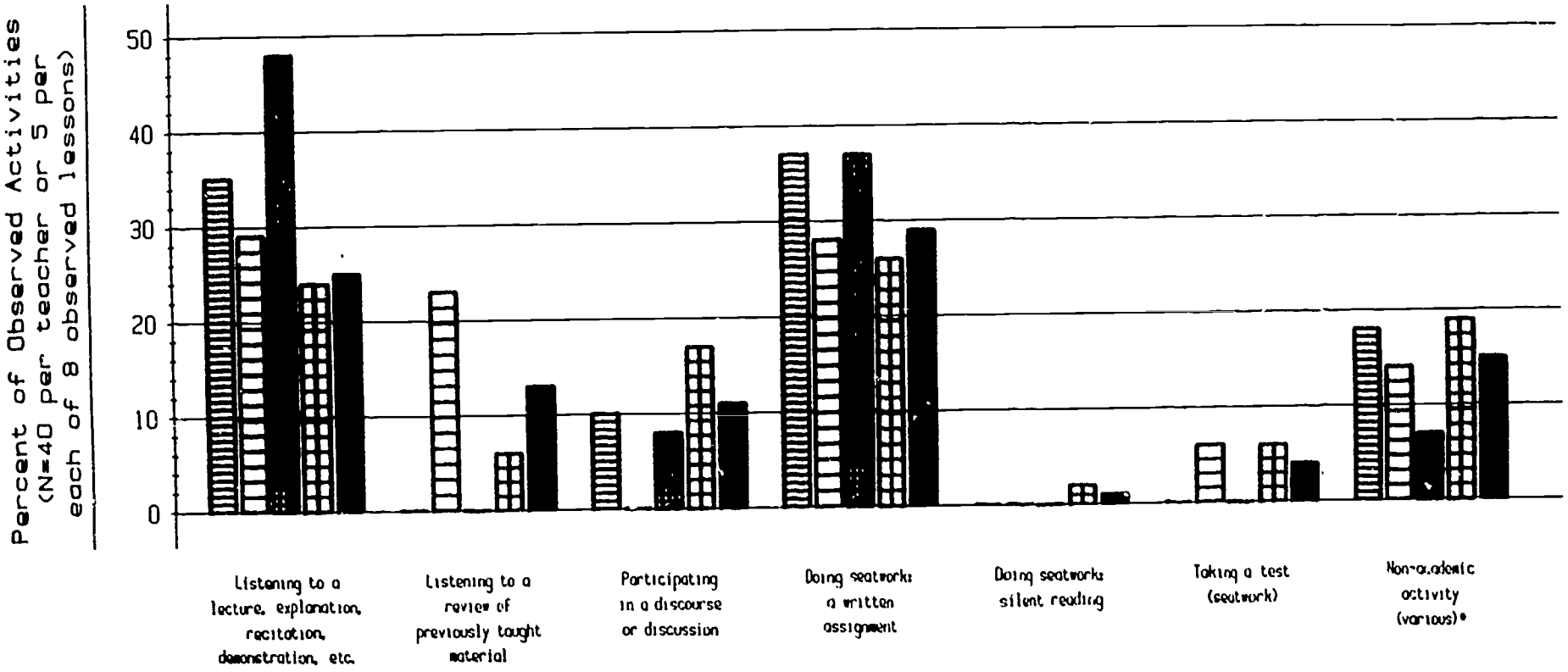
Comparison of Observed Lesson Activities

The Snapshot instrument was used on five occasions during each of the eight observed mathematics lessons per teacher and required the observer to record the type of activities assigned to the students on each occasion. Thus, our data set included forty records of student activities for each of the teachers or classrooms. Figure 3 presents the mean frequency of occurrence of each of nine predefined activities for the two profiled teachers, for the two subgroups, and for the total sample of teachers.

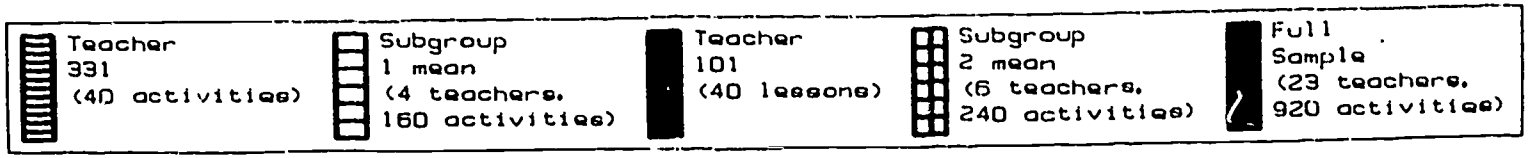
In general, these observational data support the previous interpretations of the teachers' self-reports. In particular, students in both profiled classes spent a greater proportion of the observed mathematics lessons listening to the teacher lecture, provide explanations, and the like than did students in the respective subgroups or total sample, on average. The difference between Teacher 101 and subgroup (2) was particularly great with regard to

FIGURE 3

Comparisons of the Observed Activities Assigned to Students by Two Profiled Teachers, their Respective Subgroups, and the Total Sample of Mathematics Teachers



*The category "Non-academic activity" was coded whenever the students were not expected to be involved in academic work. This included periods of transition in the lesson, attending to procedural matters, or when one or more of students was being disciplined, or when a discussion was social in nature.



this activity. In neither profiled class were students observed to be listening to a review of previously taught material, unlike the students in the subgroups and total sample. Both profiled teachers were observed to have assigned a greater proportion of class time to written seatwork than was the case for the subgroups.

There were also differences between the two profiled teachers and their subgroups relative to the observed frequency of discussions and the observed incidence of non-academic activities. However, the direction of differences varied. Teacher 331 used relatively more classroom discussion than did Group 1. There was also a relatively greater portion of time taken up with non-academic activities in Classroom 331, which may reflect the varied activity segments across the lesson and the need for periods of transition. Teacher 101 involved the students less often in discussion than did the teachers in Group 2 on average, and there were fewer recorded occasions of non-academic activities. The activities recorded for Teacher 101's lessons reveal only two types of student activities used with relative frequency; thus, there may have been few transitional segments in the lessons.

As far as test-taking was concerned, neither profiled teacher was observed to have assigned a written test to the students. Since the observers were asked not to schedule observations during mathematics lessons which would involve written tests, this difference between the profiled teachers and their respective subgroups may simply reflect a better coordination of scheduled visits with the profiled teachers, rather than any indication that these two teachers gave their students fewer tests. (Of course, that the observers were indeed able to schedule visits so as not to coincide with a test may reflect better planning on the part of the two profiled teachers.)

Across the student activity types, then, the profiled teachers did differ from their respective subgroups. The two teachers used lecturing and other forms of whole-class instruction more frequently than did the other teachers on average--though the overall correlation between whole-class instruction and achievement was found to be negative.

In sum, then, the observational data collected by means of the Snapshot instrument were consistent with the particular teaching models derived earlier as characteristic of the

strategies of Teachers 331 and 101. Consistent with the teachers' self-reports, the students in Classrooms 331 and 101 were most often observed to be listening to a teacher presentation or recitation, or doing written seatwork, and were only occasionally observed to be participating in a question or discussion format. They were never observed to be listening to a review or doing silent reading. In subsequent analyses of the more detailed information obtained from the Five Minute Interaction instrument, the types and patterns of teacher-student interactions in the two profiled classes will be examined, to see if there is any noticeable relationship between the planned lesson emphases and intentions and the subsequent organization of the lesson in terms of the amount of lecturing, questioning, monitoring, and so on.

Summary

These profile analyses are an attempt to identify teaching behaviours which might be related to significant gains in mathematics achievement over the course of the school year. To this end, two classes were found in which the mean student gain in mathematics achievement was significantly greater than in other classes with comparable pretest achievement, and these two profiled classes were then assessed vis-a-vis their comparison groups with respect to a variety of student, class, and teacher characteristics, and with respect to both self-reported and observed teaching strategies.

The analyses indicated that the significant gain in mathematics achievement in these two classes could not be attributed to differences in factors such as students' home background, class size, the number of mathematics lessons per week, or teacher workload. From the aspect of teaching strategies, however, the analyses revealed several differences between the profiled teachers and their subgroup colleagues. In particular, using a variety of sources of data, this paper has argued that the profiled teachers represent, in the one case (Teacher 331), an extremely organized approach to teaching wherein material is taught until it is mastered, thereby reducing the need to review work frequently, and, in the other case (Teacher 101), an approach which emphasizes the presentation of material followed by extensive practice in applying the material to new situations.

In sum, the two profiled teachers did appear to have adopted teaching styles for mathematics which differed in significant ways from those adopted by colleagues who taught equivalent subject matter to students with equivalent initial achievement levels. Although in planning and teaching their lessons, both teachers placed particular emphasis on new material, rather than on review, there were some differences between their teaching practices. These differences may be a reflection of the success of both teachers in diagnosing of the particular abilities of their students and adopting appropriate teaching strategies.

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